BASTA : a 95GHz FM--CW Cloud radar

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BASTA : a 95GHz FM-CW Cloud radar

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Objectives

Ground-based continuous observation of non-precipitating clouds and fog (SIRTA).

✸ **Scientific aims :**

– Improve representation of clouds and associated processes in climate and forecast models.

– Information at different time scales on dynamical cloud processes, microphysics and radiative processes.

– Better understanding of fog processes

– Refractivity studies

✸ **Operational aims :**

– Contribution to the development of cloud observation stations for a future assimilation of cloud products.

– Validation of spaceborne active remote sensing instruments, cloud radars and lidars (A-Train : CALIPSO/ CloudSat, EarthCARE in 2016).

✸ **Industrial aim :** development of a low cost radar for large scale deployment.

Blower: Remove water remaining on the radome

Weight:
Around 70kg
L x w x h :
154 x 94 x 62 cm

Specifications

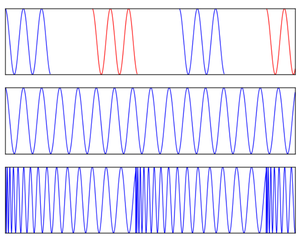
✸Cost < 100 k€
✸Antenna diameter 60 cm
✸Power ~1 W
✸Vertically pointing, bistatic, no polarisation.

Modes	Range (km)	Doppler max (m/s)	Sensitivity dBZ@1km (3s)	Targets
12.5 m	6	±10	~-38	Fog, low level clouds and drizzle
25 m	12	±5	~-44	Fog, low level clouds and drizzle and ice clouds
100 m	12	±5	~-50	Cirrus
200 m	12	±5	~-53	High cirrus

What does FM-CW stand for?

FM-CW (Frequency Modulated - Continuous Wave)

✸Principle:
Compensate the lack of power by emitting continuous signal.
As we do not have pulse, the frequency is modulated to be able to determine the echo distance.
Low power amplifier (1W vs 1-2kW for pulsed radar) => cheaper!



Instead of emitting high energy for a short period, we emit continuously less energy.
=> At the end the same amount of energy is sent!
A chirp modulates the frequency of the wave in order to code the information

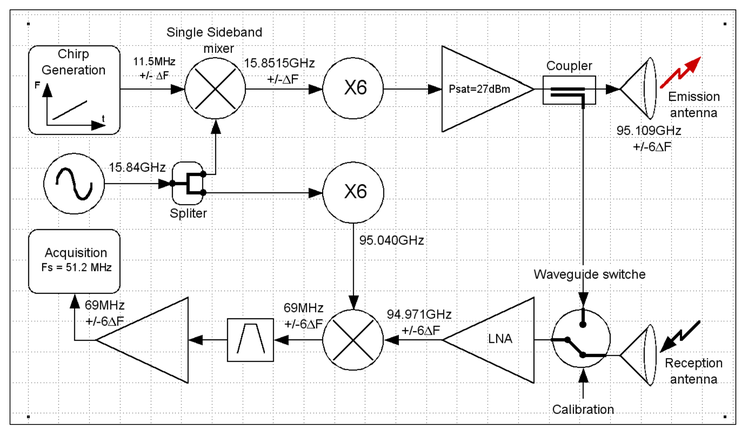
Signal processing-synoptic

Impulse Response (R) for each chirp (Radial)

$$R = FFT\left[Chirp_{received} \times Chirp_{reference}\right]$$

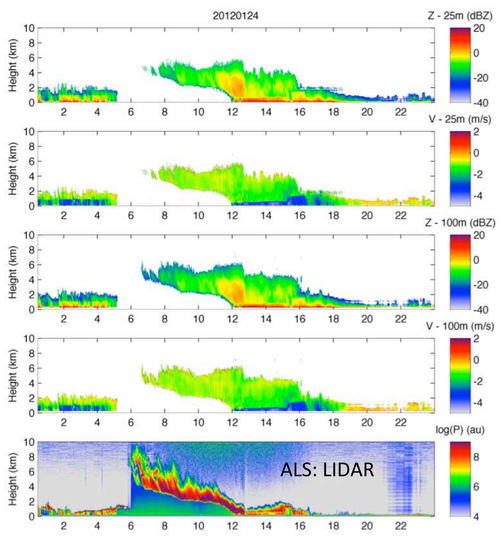
Once you have R you are back to a pulse radar:
We use PPP (Pulse Pair Processing) to derive Doppler velocity (phase) and reflectivity (module) for n radar gates

$$PPP = \frac{1}{n-1}\sum_{i=0}^{i=n-1} R_n R_{n+1}^{*}$$

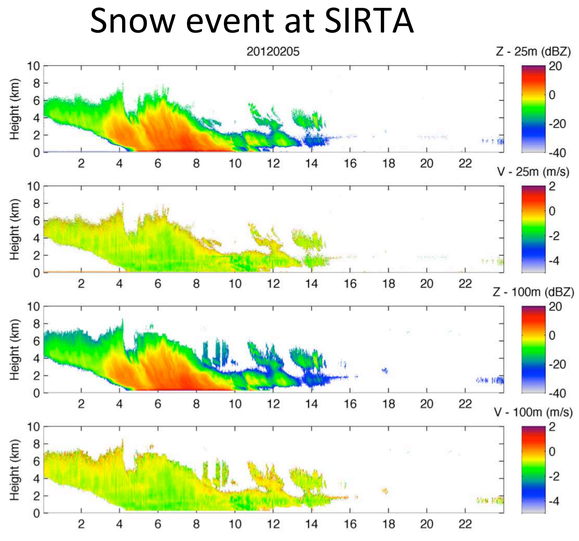


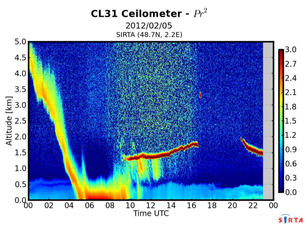
Examples

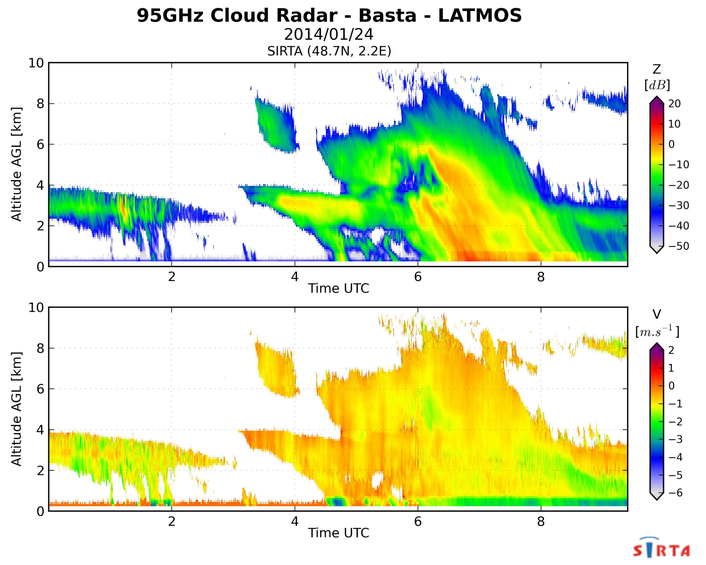
Cirrus/stratus & precipitation



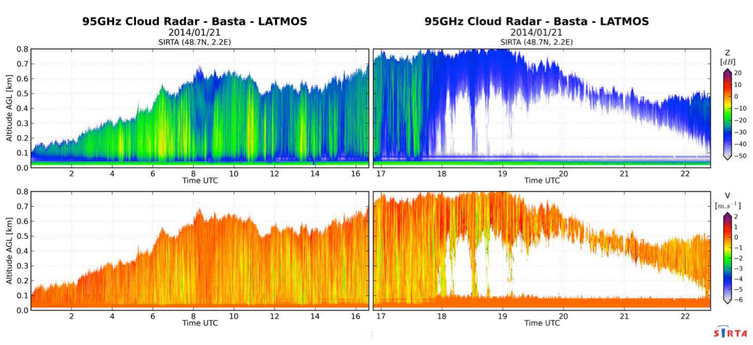
Snow event at SIRTA







Low level clouds/fog



Multi-layer clouds